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ABSTRACT

This guide provides instructional strategies and activities for improving measurement and geometry skills. In the introduction, the importance of measuring skills, the history of measurement, and instructional approaches are discussed, and a table matching activities with requisite skills is presented. The 16 activities include such topics as measurement, estimation, area, volume, problem solving, word problems, time, figures, patterns, angles, and circles. The activities include some or all of the following: objectives; materials; vocabulary; preparation; procedure; extension; and a worksheet. A sample lesson, two review/evaluation activities, measurement tools, templates, a sample LOGO program, and a feedback form are appended. (YP)

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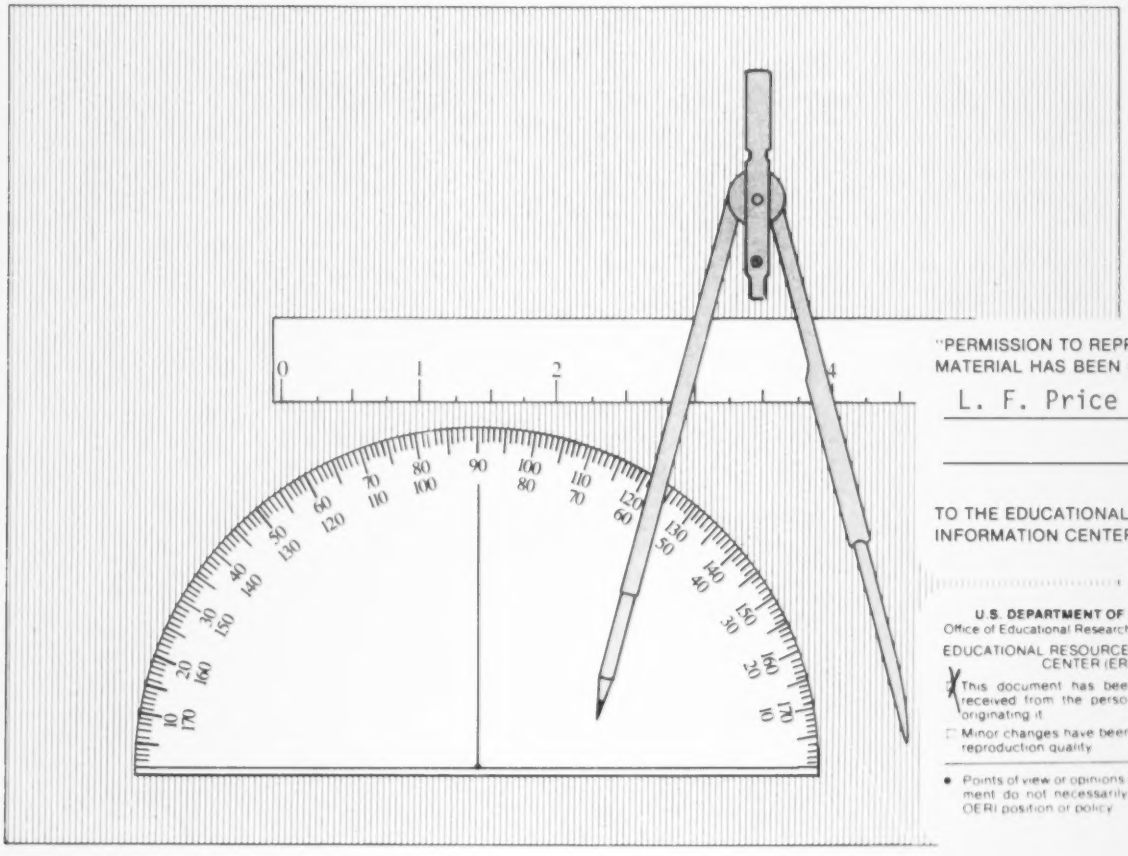
Improving Measurement and Geometry Skills of Students In Grades Four to Six



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IMPROVING
MEASUREMENT AND GEOMETRY SKILLS
OF STUDENTS
IN GRADES FOUR TO SIX

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FOREWORD

The New Jersey State Department of Education has recognized the High School Proficiency Test not only as a measure of the basic skills mastered by students in the ninth grade, but also as an indicator of K-9 instruction. This product is designed to address some needs in the area of mathematics instruction in the elementary school. The materials presented herein focus specifically on instruction in measurement and geometry.

The ability of students to judge or estimate distances, weight, and height is one of the most valuable skills learned in the classroom and used for survival. The development of the ability to measure precisely and accurately can not be emphasized enough by instructors. Comparing the characteristics of geometric shapes and learning to calculate correctly the size of various objects will foster a spacial awareness in students that will serve them in all domains of their lives. The purpose of this product is to address the development of measurement and geometry skills that are appropriate among fourth, fifth, and sixth graders and that will afford success in future experiences.

Within this document, teachers will find a variety of instructional strategies and activities which they may adapt to meet the needs of their students. Additional direction is available through training sessions in mathematics, as well as in writing and reading, at the three Regional Curriculum Services Units.

Saul Cooperman
Commissioner

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BACKGROUND

Mark J. Driscoll, addressing the topic of measurement in Research Within Reach: Elementary School Mathematics, notes several important points for consideration by teachers of children in grades four, five, and six. Some of these points are:

- There are specific skills and concepts of measurement which children should learn, whether they learn these in the metric or in the traditional language. As they develop the appropriate skills and conceptual understanding, learners undergo a developmental process that both contributes to and is influenced by the pace of cognitive development.

- Things we choose to measure have several attributes:

area	length	speed
capacity	pressure	temperature
density	volume	viscosity
distance	weight	time

  Underlying the measurement of any one of these attributes is a larger concept linking these activities, which is a recognition that things can be measured in units.

- Whether things are measured in yards or meters is of secondary importance in the education of a young child. Of primary importance are the concepts and skills of measurement, which are the same regardless of the measurement unit used.

Driscoll asserts that various measuring practices help children to understand and work with measurement concepts and that all of these practices deserve regular and careful attention in the classroom. Some of the instructional focuses which use these practices regularly are:

- estimating
- counting
- partitioning
- indirect measuring
- using instruments
- computating

In introducing students to measurement in grades four to six, we assume that they have developed the foundation and readiness skills and passed through certain requisite cognitive stages. The curriculum guidelines devised for the intermediate grade level reveal our expectations of student accuracy in measurement. The curriculum guidelines for the intermediate grades, set by the New Jersey Department of Education and called Curriculum Benchmark Skills, however, support a spiraled learning during which students begin learning the skills tested on the High School Proficiency Test in the early grades, but develop mastery of them gradually over time.

We need to think of measurement skills, therefore, as building blocks that need to be maintained and enhanced at each grade level. Some of the "building" skills recommended in Research Within Reach are:

- **Perception.** "Perception is readiness; it is vocabulary building, and it is a foundation for understanding."

- **Comparison.** "Which will require more paper to cover, the bulletin board or the door? How could you find out?" "Who is taller, Margaret or Barbara? How could you find out?"

- **Nonstandard measurement.** Before children begin to work with inches, centimeters, and so on, teachers have the opportunity to help them relate the measurement process to their immediate environment by using convenient nonstandard measures.

- **Standard measurement.** The move from nonstandard to standard measurement can be gradual or nearly simultaneous. What is important is that the children practice measuring on a regular basis and that they select appropriate units.

History of Measurement

The Egyptians and Babylonians developed the first systems of measurement known to Western Civilization. The Egyptians were concerned with measuring the land in order to lay out the distribution of crops after the flooding of the Nile River. The Babylonians based their calculation of a year's time on the movement of the stars rather than on the earth's orbit around the sun. The Babylonian calculation of 365 days, 6 hours, and 11 minutes was rather accurate because it is within 3 minutes of the modern calculation.

Both Egyptians and Babylonians used units of measure based on the dimensions of the human body, as did the ancient Greeks and Romans. The development of such systems of measure led people of the ancient world to create the science of geometry, which grew to its maturity with the Greeks. The English word geometry comes from the Greek "geo", meaning earth, and "metron", meaning measure. Thus, geometry means "earth measure."

Some units derived from the human body and in common use, were:

UNIT	RELATION TO THE HUMAN BODY	STANDARD MEASUREMENT
fathom	the distance between a man's hands when his arms are outstretched.	6 feet
cubit	the distance from the elbow to the tip of the middle finger.	17 to 21 inches
hand	the width of the hand.	4 inches
digit	the width of the index finger.	3/4 inch
foot	the distance from the heel of the foot to the tip of the great toe.	12 inches
yard	the length of the arm from shoulder to the tip of the middle finger.	3 feet
rod	the length of the line formed by sixteen men standing left foot behind left foot.	16 1/2 feet

Measurement varied, of course, with the size of the person serving as the standard for measuring. Edward I of England (1239 - 1307), however, finally established the first fixed standard, an iron rod with a length that was defined as one yard; and standardization thus was begun.

The idea for the metric system began in 1790 during the French Revolution when the French Legislative Assembly authorized mathematicians to devise a more democratic system of measurement for length, weight, and volume. During the next twenty years, the particulars of the system were developed, but it was not until 1811 that these measures were adopted. The logic underlying the metric system, which is based on powers of ten, is maintained in the language that we use to discuss metric measurement. The prefix tells what part of the entire unit is being used. The root word tells you if you are using length (meter), weight/mass (gram), or volume (liter). In recent years, several major industries have made the use of the metric system more common. Some of these industries are Sun Oil and the major soft drink companies, who use liters for measurement.

Movement and Geometry

Since measurement and geometry were conceived in movement through and manipulation of situations that were real in history, it seems logical that movement and manipulation enhance the skills and concepts of geometry. This relationship is addressed by Rosalie Jensen and Deborah C. Spector (1986) in the article, "Geometry Links the Two Spheres." The authors state that:

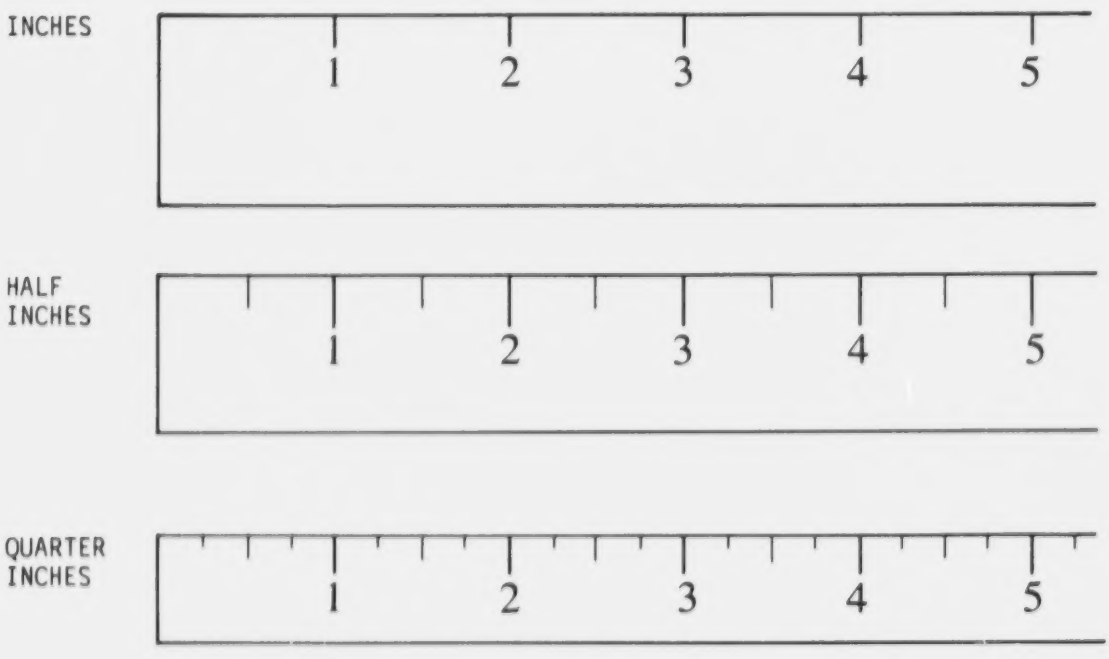
> Movement is the key to spatial awareness. From infancy on we move outward in ever-widening circles, exploring all that is within our grasp.
>
> At least one mathematical skill, the ability to analyze spatial relationships, is a right-, rather than left-brain function. According to M.S. Gazzanig, manipulative skills and geometrical competence occur before left-hemisphere linguistic competence (Sagan, 1977, 172). Thus, geometry provides a good starting point for the use of movement in mathematics.
>
> Although the particulars on how the two cerebral hemispheres work together are not known, a growing body of research shows that they can enrich each other. The implication is that a student's understanding of mathematics can be affected in a positive manner by developing the creative spatial skills of the right hemisphere.
>
> Abstract geometric ideas developed through movement and imagination can unleash cooperative efforts between the two hemispheres of the brain. We hope that your search for ways of teaching geometry through movement will lead you to find other topics in the curriculum that can be enhanced through the use of both cerebral hemispheres.

Measurement and Precision

When we discuss measurement skills, it is necessary to stress the good habits of accuracy and precision. These can be developed when students use rulers (both metric and traditional) to measure a strip of paper to the smallest unit appropriate to their development, or when they use a graduated cylinder to look for the milliliter level where the water touches the glass. (Warn students about the convex or concave menisci.) Regardless of the type of measuring activity, make it their goal to be as precise as possible.

In keeping with this early development of good habits in measurement, students should be introduced to and consistently reinforced in their use of denominate numbers. Students need to know about and to practice using denominate numbers. A denominate number is the numerical quantity used with a unit of measure, such as 3 inches, 2 pounds, or 5 gallons. Help students develop the habit of stating both the number and the unit as a complete answer, as with, for instance, 28 grams or 32 minutes.

PROGRESSIVE SAMPLE RULERS



When working with metric units, a chart, such as the one below, presented in conjunction with a review of place value will help students to think about the meaning of the prefix.

METRIC CHART

NOTE: A table of measures can be found on pages 68-69 of Appendix C.

INSTRUCTIONAL APPROACHES

In order for students to feel successful in the study of measurement and geometry, they must have many and varied experiences in measuring objects. The use of the ruler, the yardstick, and the meter stick will provide the hands-on opportunities necessary to bring the concept of measurement alive. Essential to this experience, too, is the development of accuracy and precision in measurement to one-sixteenth of an inch or to one millimeter. Also, the use of denominate numbers must become part of the natural response of students.

Another way to develop concepts of measurement is to afford practice in using nonstandard instruments of measure. For instance, students can use beans or paper clips to find the length and width of a textbook. This activity later can be extended to using those same beans or paper clips to determine the perimeter of the same book. Comparative thinking and estimation can be introduced and reinforced through the use of several different nonstandard units of measurement to determine the measurements of that same book. Deductive reasoning should be a natural offspring of these activities.

Still another path to success in measurement and geometry is having students actually construct two-and three-dimensional objects and figures. The use of various materials to construct the same shape (e.g., a square from both toothpicks or straws) is one method; the use of the same material to construct several different shapes (e.g., straws to construct triangles and squares) is another. Once students complete the construction a discussion of the attributes of each figure is a means to extend student understanding. Investigation of existing shapes and figures in whole group or small group settings will reinforce the characteristics of geometric shapes.

Students' grasp of logic in comparing graduated units to measure objects (e.g., in comparing the capacity of a pint with that of a quart) should not be assumed; it should be developed. A collection of clean cartons that increase in capacity from half-pint to a gallon is a starting point. The transfer of "something" (it does not have to be liquid if you anticipate spilling) from a gallon container to a half-gallon one will demonstrate the overflow of material. The transfer of a substance up from half-pint to pint will demonstrate the need for more of that substance. Multiple containers of one size used to compare their contents to a container of greater size followed by a discussion can enhance critical thinking and problem-solving.

Measurement and geometry can be a springboard for reinforcement of skills that have been introduced in other mathematical topics. The concepts of fractions and the maintenance of skills with fractional parts are reinforced by the use of the fractional divisions on a ruler. In measurement with metric length, capacity, and mass/weight, the renaming of the unit of measure affords practice in multiplication and division of decimals. Pre-algebra skills are approached in a logical way through the substitution

of numerical values in geometric formulas. In conclusion, measurement and geometry can supplement topics that are taught throughout the year. In the same way, once a unit of measurement and geometry has been taught, the unit can be reinforced and skills maintained by the integration of those skills with units on fractions and decimals.

ACTIVITY SKILL MATCH
CURRICULUM BENCHMARKS AT THE INTERMEDIATE LEVEL

ACTIVITY	SKILL
1. Measurement with Nonstandard Units	28. Add, subtract, multiply, and divide measures 34. Find the perimeter of a polygon
2. Estimation of Weight	28. Add, subtract, multiply, and divide measures
3. Estimation of Length and Weight	28. Add, subtract, mutiply, and divide measures
4. Measurement in Centimeters	28. Add, subtract, multiply, and divide measures 32. Read a ruler
5. Measurement in Inches	28. Add, subtract, multiply, and divide measures 32. Read a ruler
6. Estimating with Measurements	28. Add, subtract, multiply, and divide with estimated measures 29. Find the approximate area of a specified figure 34. Find the approximate perimeter of a polygon
7. Area of Polygons	41. Find the area of a rectangle
8. Area of Rectangles	29. Find the area of a specified figure

ACTIVITY	SKILL
	41. Find the area of a rectangle
9. Volume with Cubes	28. Add, subtract, multiply, and divide measures 32. Reinforce reading of a ruler
10. Problem Solving with Measures: Time	28. Add, subtract, multiply, and divide measures of time and distance 30. Solve a problem involving time
11. Time	30. Solve a problem involving time
12. Measurement of Time	30. Solve a problem involving time
13. Problem Solving with Temperature	28. Add, subtract, multiply, and divide measures 33. Work with thermometers given a temperature on a Fahrenheit and/or Celsius thermometer
14. Identify figures and patterns	40. Identify geometric figures
15. Types of Angles	35. Understand the concept of a right angle
16. Circles	38. Identify center, radius, and diameter of a circle 39. Understand the relationship between radius and diameter

ACTIVITIES

Organization of Activities

The organization of the activities that follow is developmental, proceeding from the concrete to the abstract. Students will find length before perimeter, area, volume, or capacity.

The value of student discussion as a tool for discovering mathematical concepts cannot be emphasized enough. Because the experiences may vary from classroom to classroom, the activities that follow do not always call for discussion when in fact student dialogue may be appropriate. As pupils proceed through these activities, encourage them to verbalize what they are finding out as they compare and contrast estimates and measurements.

1. Measurement with Nonstandard Units

Objective: **Students will estimate the length of items, using nonstandard units. ("Length" usually indicates the longer of the two dimensions.)**

Note: Students derive invaluable feedback when they verify estimates by actually measuring. In this particular activity, as well as others, students may benefit from a discussion of situations in which accuracy is important and a discussion of techniques for making more accurate estimates.

Benchmark Skills

28) Add, subtract, multiply, and divide measures
34) Find the perimeter of a polygon

Materials: paper clips, pencils, shoes, and baggies

Vocabulary: measurement, approximate

Preparation: Instruct students that when people had no standard instruments of measurement, they used what they had on hand. Give the students three units of measure: a paper clip, a pencil, and a shoe. Explain that the students will use these units to find the approximate measurement of some common items.

Procedure:

1. Assign the students to work in small groups.
2. Give each group a sandwich bag filled with paper clips and an unsharpened pencil.
3. Tell each group to place one math book on the table.
4. Have students place a paper clip next to the book and then estimate how many paper clips long the book is. Answers should be in paper clips.
5. Do the same with the width.
6. Ask students to use different-sized items for measuring.

Use the paper clip to measure the book.

a. How many paper clips long is the book?
b. How many paper clips wide is the book?
c. How many paper clips will you need to get completely around the perimeter of the book?

Use the long side of the math book to measure the desk.

d. How many math books long is the desk?
e. How many math books wide is the desk?

7. Ask one student from each group to stand at each table.

8. Have the group use the unsharpened pencil as the unit of measurement for estimating the height of the child who is standing. (The unsharpened pencil makes measurement close to uniform.)

9. Call on students of different heights, and ask each in turn to stand. Then ask the class to estimate how many pencils taller you are than each of these students.

Extension:

- Turn their attention to something outside the window (a fence, a tree, a telephone pole). Ask the students to estimate the height. Discuss their answers.

  a. How many pencils high is the fence?
  b. How many pencils high is the tree?
  c. How many pencils high is the telephone pole?

  Note that the distance of the object from the group will affect estimates of the object's height.

- Ask each group to take a shoe and trace the shoe on a piece of paper. Next, students should cut out the shoe. Ask the groups to estimate the length of the classroom in paper shoes. (Lengths of adding machine tape may also be used.)

  a. Approximately how many shoes long is the room?
  b. Approximately how many shoes wide is the room?

2. Estimation of Weight with Nonstandard Units

Objective: **Students will estimate the weight of items using nonstandard units.**

Note: This activity is a follow-up to the activity, Estimation of Length with Nonstandard Units. Have students practice estimating weight using a variety of nonstandard units of measure.

Benchmark Skills
28) Add, subtract, multiply, and divide measures

Materials: beans, pencils, double-pan balance scales, spring scales, and sandwich bags

Vocabulary: estimate

Procedure:

1. Use a double-pan balance scale. Place a pencil on one pan. Ask the students to estimate how many beans need to go on the other pan in order to balance the scales.
2. Place several pencils on one side of the scales. Ask how many beans are needed to balance the scale. Have students discuss ways of predicting how many more beans it would take.
3. If spring scales are used, fill a sandwich bag with beans and attach it to the spring scale. Record the weight.
4. Ask students to estimate how many pencils it will take in order to get the approximate weight of the bag of beans.
5. Reverse the order by placing ten pencils in a bag and weighing them on the spring scale. Ask the students to estimate how many bags of beans it will take to get that same weight.

Extension: Present a set of pencils that will weigh only a "fractional part of one bag of beans. Have students estimate the answer.

3. Estimation of Length and Weight

Objective: **Students will discuss and estimate measures.**

Benchmark Skills
28) Add, subtract, multiply, and divide measures

Materials: rulers and balances or scales.

Vocabulary: length, width, weight

Preparation: Encourage the children to think about and discuss each example in the two charts. You may wish to provide pictorial examples of the various measurements. Ask the children to show you things under their desks or in their pockets that may be a certain length or weight, and encourage a discussion. If you wish, measure or weigh the materials.

Procedure:

1. Ask students questions such as:

   a. What unit would you use to weigh a book?
   b. What unit would you use to measure a car?

2. Generate a discussion about choosing appropriate units of measurement.

3. Distribute the Estimation Worksheet, and ask students to circle the approximate measurement for each item listed.

Extension: Encourage the children to offer their own examples and have their classmates choose the best estimate of length or weight.

LENGTH

Unit	Matches	Example
1 inch (in.)	-	A quarter is about 1 inch across
1 foot (ft.)	12 inches	A notebook is about 1 foot long
1 yard (yd.)	3 feet, 36 inches	In 2 steps, you walk about 1 yard
1 mile (mi.)	5280 feet	In fifteen minutes, you could walk 1 mile

WEIGHT

Unit	Matches	Example
1 ounce (oz.)	-	A silver dollar weighs about 1 ounce
1 pound (lb.)	16 ounces	A large can of tuna weighs about 1 pound
1 ton	2000 pounds	A compact car weighs about 2 tons

ESTIMATION WORKSHEET

Which of the following measures is the best estimate of the approximate length or weight? Circle the best answer.

1.	Your weight	6 pounds	60 pounds	600 pounds
2.	Your height	5 inches	55 inches	550 inches
3.	The length of your foot	1 foot	1 yard	1 mile
4.	The weight of a hamburger	4 ounces	40 ounces	400 ounces
5.	The weight of an elephant	2 ounces	2 pounds	2 tons
6.	The height of a horse	2 inches	2 feet	2 yards
7.	The length of a bird	9 inches	9 feet	9 yards
8.	The weight of a lion	250 ounces	250 pounds	250 tons
9.	The height of a room	12 inches	12 feet	12 yards
10.	The weight of a safety pin	.1 ounce	.1 pound	.1 ton

4. Measurement in Centimeters

Objective: **Students will use metric rulers to determine accurate measure.**

Note: Use a teacher - prepared activity sheet displaying rulers with metric units. Assign letter values to each unit on these rulers, as in the Metric Worksheet on page 19. Students will read the ruler and give the numerical value of single letters and of words.

Benchmark Skills

28) Add, subtract, multiply, and divide measures
32) Read a ruler

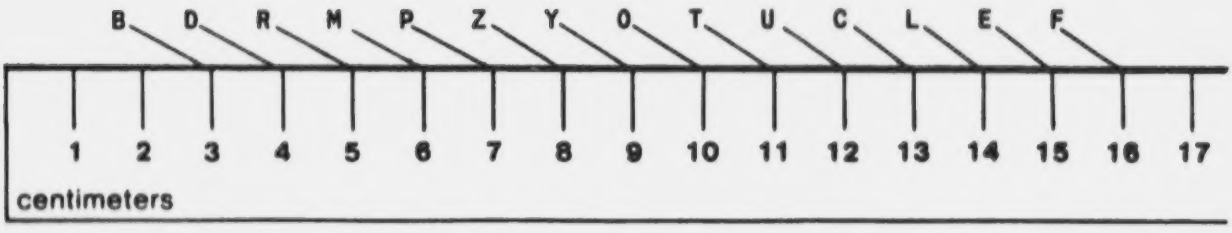
Materials: Metric Worksheet, rulers (see Appendix D, page 71, for templates), and pencils

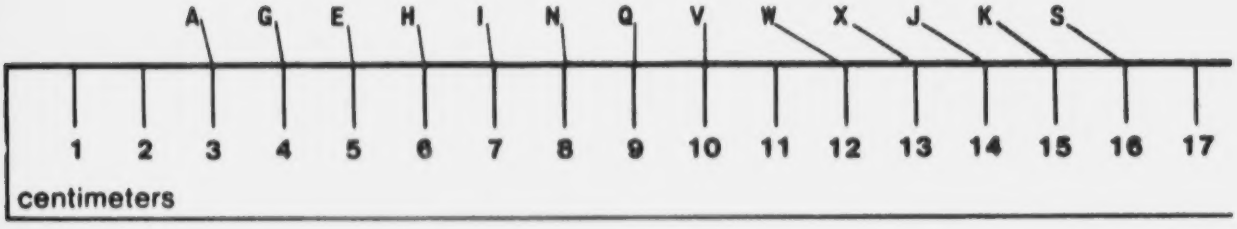
Vocabulary: metric

Procedure:

1. Before you begin this activity, review the proper and accurate way to read a ruler with the whole group.
2. Distribute the Metric Worksheet on page 19, and call attention to the alphabet letters that have been assigned to the metric markings.
3. Explain to students that they will find the numerical value for different letters and for words. Point out that some words use letters from both metric rulers.
4. Demonstrate this activity. Then have students work independently to find the numerical values.

METRIC WORKSHEET





Examples: X = 13 cm NO = N + O

NO = 8 cm + 10 cm = 18 cm

Find the value of these letters and words.

G _____ F _____ FROG _____ POND _____

V _____ X _____ ROCK _____ STONE _____

P _____ J _____ MIND _____ IDEA _____

Extension: Use the metric rulers to find the number value of each word. Then perform the operations to find the answers.

Metric Example:

OUT + HIT =

10 + 12 + 11 + 6 + 7 + 11 = 57

ROME + PARIS =

MATH + READING =

LUNCH - ROOM =

LETTERS - NUMBERS =

Use the metric rulers to find the total of the words in each box.

JUMP	BIRD
PEN	NEST
BUG	WORM
DOG	EGG

5. Measurement in Inches

Objective: **Students will use customary units of inches, half inches, and quarter inches to determine measurement.**

Note: Use a teacher-prepared activity sheet displaying rulers with customary units of measures. Assign letter values to each unit on these rulers, using half and quarter inches if they are appropriate for the instructional level of the students. Students will read the ruler and give the numerical value of single letters and of words.

Benchmark Skills

28) Add, subtract, multiply, and divide measures
32) Read a ruler

Materials: Customary Worksheet, rulers (see Appendix D, page 71, for templates), and pencils

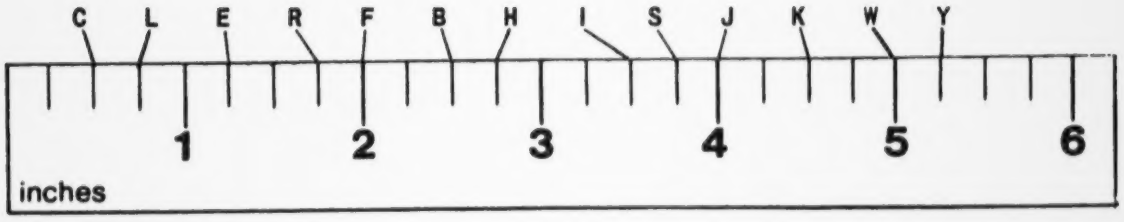
Vocabulary: customary measure

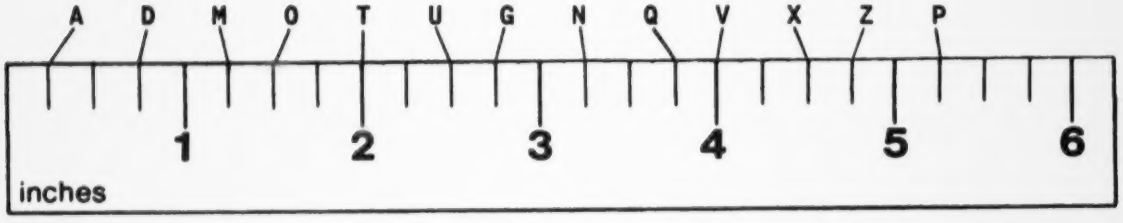
Procedure:

1. Review the proper and accurate way to read a ruler.
2. Distribute the Customary Worksheet on page 22, and call attention to the alphabet letters that have been assigned to the inch, half-inch, and quarter-inch markings.
3. Explain that with these rulers students will find the numerical value for different letters and for words. Point out that some words use letters from both customary rulers.

Note: The illustration of the rulers and the examples for this activity should be adapted (showing only one-inch or one-inch and half-inch markings) if students are not yet ready to deal with the smaller fractional parts.

CUSTOMARY WORKSHEET





Examples: b = 2 1/2

HI = H + I

HI = 2 3/4 + 3 1/2 = 6 1/4

Find the value of these letters and words.

A _____ Q _____ BAG _____ SACK _____

M _____ L _____ DOT _____ POINT _____

H _____ U _____ CLIP _____ BAND _____

Extension: Use the customary rulers to find the number value of each word. Then perform the operations to find the answers.

Customary Example:

SO + AD =

3 3/4 + 1 1/2 + 1/4 + 3/4 = 6 1/4

SKY + AIR =

FLAG + CLOUD =

CUP - ADD =

STAR - MOON =

Use the customary ruler to find the total of the words in each box.

FUR	PIG
TAIL	COW
PAW	LAMB
CAT	HEN

6. Estimating with Measurements

Objective: **Students will estimate perimeter and area.**

Benchmark Skills

28) Add, subtract, multiply, and divide measures
29) Find the area of a specified figure
34) Find the perimeter of a polygon

Materials: paper and pencil, Estimation and Measurement Chart

Vocabulary: Use the prefixes below.

Prepartion: Review the metric units of length with the class:

METRIC PREFIXES:

Base Units

meter

kilo	hecto	deka	liter	deci	centi	milli
1000	100	10	gram	.1	.01	.001

NOTE: THE UNDERLINED UNITS AND PREFIXES ARE USED MOST OFTEN.

Metric Equivalents

10 millimeters (mm) = 1 centimeter (cm)
10 centimeters (cm) = 1 decimeter (dm)
10 decimeters (dm) = 1 meter (m)
10 meters (m) = 1 dekameter (dam)
10 dekameters (dam) = 1 hectometer (hm)
10 hectometers (hm) = 1 kilometer (km)
1000 meters (m) = 1 kilometer (km)

Procedure:

1. Give some concrete examples of commonly used units, such as a 50-meter swimming pool, that students will feel comfortable with as points of reference.

2. While the formula for finding the perimeter of a rectangle on the chalkboard.

   $$P = 2l + 2w \quad \text{or} \quad P = 2(l + w)$$

3. Have students place a clean piece of paper on their desks. Tell them to fold the paper in three columns and label one column **item**, the next column **estimation of perimeter**, and the third column **actual perimeter**.

4. Ask students to list several items in the item column, such as desktop, math textbook, floor of the classroom, chalkboard, and so on.

5. In the second column, have students write their estimate of the perimeter using centimeters or meters as the unit of measurement. **Note**: All calculations are to be done in their heads.

6. Next, write the formula for finding the area of a rectangle on the chalkboard. It is appropriate at this time to discuss why the answers to calculations of area will be the squared measurements.

7. Discuss estimations, determine reasonableness of answer.

8. Once they seem comfortable, have them go back and find the area of each item on the list. Again, all calculations are to be done in their head. Only the answers go on the paper. It may be necessary to walk around and check on the "mental arithmetic".

SAMPLE PAPER

Item	Estimation of Perimeter	Actual Perimeter
1. Notebook	110 cm	600 sq. cm

Item	Estimation of Area	Actual Area
1. Desk	700 sq cm	840 sq cm
2. Notebook	110 sq cm	99 sq cm

ESTIMATION AND MEASUREMENT CHART

Item	Estimation of Perimeter	Actual Perimeter	Estimation of Area	Actual Area
1. Classroom				
2. Teacher's desk				
3. Chalkboard				

7. Area of Polygons

Objective: **Students will find the area of rectangles.**

Benchmark Skills
41) Find the area of a rectangle

Materials: many one-inch squares (see Appendix D, for templates), triangles, shoe box lids, and paste. (Note: Triangles may be prepared by dividing some one-inch squares along the diagonal).

Vocabulary: rectangle, area

Preparation: Discuss the tile on the floor of a room. Instruct the children that this is covering the area of the room. Tell the students that they will use squares that are one-inch squares to cover the inside of the lid to a shoe box.

Procedure:

1. Assign students to work together in small groups of three or four.
2. Give each group a pile of squares, a larger pile of triangles, two shoe box lids (close to the same size), and paste.
3. Tell the students to cover the inside of one lid, using only the paper squares.
4. Encourage students to manipulate the squares by folding them into halves or quarters in order to cover the entire lid.
5. Have students estimate the total number of paper squares used to cover the lid.
6. Ask students to count or compute the actual area and record the answer.
7. Have the students follow the same procedures as in steps 3, 4, 5, and 6, using the triangles to cover the inside of the second lid.

8. Evaluate comprehension by asking some questions, such as:

   - How many squares were used to cover the lid?
   - How many triangles were used to cover the second lid?
   - What do you think makes a difference in the total units used to cover each lid?
   - How did you deal with the units when you could not use a whole square or triangle?
   - If you used half-inch squares or quarter-inch squares, how would the area change?

Extension: Have students draw rectangles of given areas on the one-inch square grid paper (See Appendix D for a template). Compare their rectangles. Extend this activity to include working with irregular figures.

8. Area of Rectangles

Objective: **Students will compute the area of polygons.**

Note: This activity can be used for skill maintenance.

Benchmark Skills

29) Find the area of a specified figure
41) Find the area of a rectangle

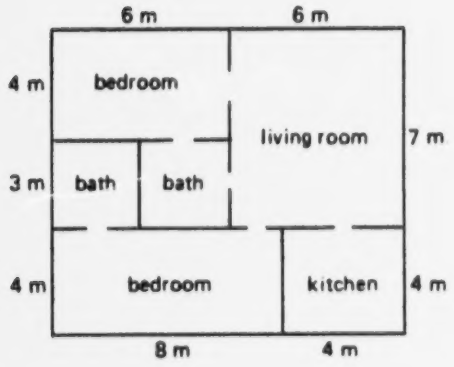
Materials: Computation Worksheet

Vocabulary: polygon, area, scale drawing

Procedure:

1. Students can complete this activity individually.
2. Review the concept of area.
3. Distribute the Computation Worksheet, and discuss the floor plan that is presented in this activity. Then ask students to perform the operations necessary to answer the questions.

Floor Plan



COMPUTATION WORKSHEET

FORMULA: A = l x w

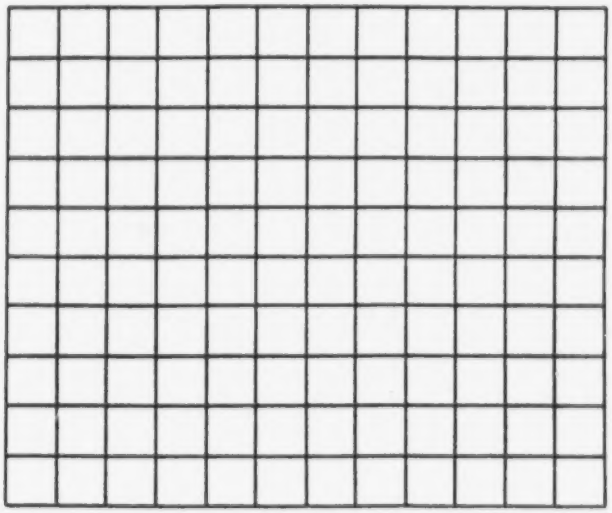
1. What is the total area of the house?

2. How much carpet is needed for the living room?

3. How much carpet is needed for the two bedrooms?

4. Tiles for the kitchen floor cost 50¢ each. If 9 tiles cover one square meter, what is the cost of covering the entire kitchen floor?

Extension: The pattern of squares below is called a grid. On this grid, make a scale drawing of your own classroom or of a room in your home. First measure the room, and decide on a convenient scale. Show the scale you are using.



Write two word problems for your scale drawing.

9. Volume with Cubes

Objective: **Students will find the volume.**

Benchmark Skills
28) Add, subtract, multiply, and divide measures 32) Read a ruler

Materials: rulers (metric and customary), several bags of caramels, about 5 sets of color cubes, sugar cubes or wooden blocks, a clear shoe box or plastic container, tupperware containers, and small gift boxes

Vocabulary: volume

Preparation: After students have used length and width to find the perimeter and area, explain volume. Provide students with a mental picture of volume by having them imagine a closet packed tightly with shoe boxes, a warehouse completely filled with large boxes, a rectangular ice cube bin completely filled with ice cubes, and a shoe box filled with blocks or cubes.

Procedure:

1. Hold up 1 cube, and measure it for the entire group. Be consistent. If you begin in metric, have the students use metric. If you use customary, insist that the class use customary.

2. Calculate the volume, and state the value of the cube (giving both the denominate number and the unit of measurement). Depending on the instructional level of the students, it may be most appropriate simply to name your unit of measure a "cube unit."

3. Use the clear or plastic box to demonstrate three dimensions, length first, width second, and height third, layering the cubes to show volume.

4. If the cubes do not fit completely, use a fractional or decimal part of the cube (by cutting the cubes into equal or fractional parts) in order to find the total area and the total volume.

5. Model the need for fractional and decimal computations.

6. Assign the students to work in groups of three or four.

7. Give each group a set of cubes and a box. Vary the size of the boxes.

8. Have students model your demonstration, record what they do, and give an answer in proper form, using denominate numbers and the unit of measurement.

9. Ask a member of each group to report on how they counted or computed the volume of their box.

10. Repeat your demonstration, this time writing down the dimensions on the chalkboard.

11. Then demonstrate the computation of the volume, writing the formula and substituting the proper value for each dimension. Discuss the procedure with the students.

12. Have the groups exchange boxes and repeat steps 8 through 12.

Note: If this is the first time students have seen exponents used with denominate numbers, explain the exponent. Display a place value chart of base ten.

Extension: Have students estimate the volume of several boxes. Use the formula, or fill the boxes with cubes to compare the exact volume with the estimate.

If nonstandard units are used for the activity, give students a similar activity that requires the use of standard units.

10. Problem Solving that Measures Time

Objective: **Students will calculate time.**

Benchmark Skills
28) Add, subtract, multiply, and divide measures 30) Solve a problem involving time

Materials: old clocks, watches, calculators, large poster board paper, and Time Measurement Worksheet

Vocabulary: time measurement, leap year

Preparation: Encourage students to think about and discuss time and the use of time in their day. For the child who is familiar with only a digital clock, a review of the face of the 12-hour clock may be an essential introduction to this activity.

Procedure: 1. Present the Table of Time Measurement.

Table of Time Measurement

60 seconds = 1 minute

60 minutes = 1 hour

24 hours = 1 day

7 days = 1 week

52 weeks = 1 year

12 months = 1 year

365¼ days = 1 year

10 years = 1 decade

100 years = 1 century

2. Encourage a discussion of the data.

3. Ask students to answer such questions as

   - How many hours in three days?
   - How many months in a half a year?
   - How many days in five years? (include one leap year)

4. Discuss when it is appropriate to use calculators.

5. Display the Table of Time Measurement for the students to refer to when problem solving.

Extension:

- Ask students to draw or construct a clock. Tell them to write three word problems based on time differences. Then have them exchange their problems with other students and solve the problems.

- Ask students to construct a twelve-month calendar and to make sure that each month has the proper number of days. Tell them to write word problems involving days, weeks, and months. Then have them exchange their problems with another student and solve the problems.

TIME MEASUREMENT WORKSHEET

Solve the following:

1. How many minutes from 10 A.M. to 2 P.M.?

2. Express in years: 36 mo., 30 mo., 6 mo., 18 mo., 9 mo., 42 mo., 60 mo.

3. How many days in: 3 wk., 10 wk., 17 wk., 12 wk., March, November

4. Express in hours: 60 min., 30 min., 20 min., 80 min., 1 day, 3 days

5. A baby is 9 weeks old. About how many days is that?

6. From 7 A.M. to 5 P.M. is how many hours?

7. What time is it 7 hours before 3 P.M.?

8. Juan arrived at 2:20 P.M. It took him 6¼ hours to make the trip. What time did he leave?

9. Chen Ying wants to arrive at 10:00 A.M. It will take 3 hours and 10 minutes to travel. What time should she leave?

10. Carol walked two miles in 27 minutes, 30 seconds. Diane walked four miles in 1 hour, 6 minutes. Who was walking faster?

11. Solve a Word Problem Involving Time

Objective: **Students will calculate distance in order to solve a problem.**

Note: Quick review lessons serve as a way to monitor students' maintenance of skills. This activity and ones similar can be used for review from time-to-time.

Benchmark Skills

30) Solve a problem involving time

Materials: Time/Distance Worksheet and Table of Measures (Appendix C)

Vocabulary: distance

Procedure:

1. Discuss the measurement of time and distance, referring to a Table of Measures, such as the one in Appendix C on pages 68-69.
2. Display the measures needed by the students in their calculations.

Extension: Have students create a star. Let them decide how many light years away from earth the star is. Ask them to calculate the distance in kilometers from earth to their star.

TIME

Problem A

Before buying a space ship, the Wright family decided to learn about the great distances in space. Such distances are measured in light years. Light travels about 300,000 km in one second. A light year is the distance light travels in one year.

Complete the table the Wrights started.

TIME	DISTANCE LIGHT TRAVELS
1 second	300,000km
1 minute	
1 hour	
1 day	
1 year (365 days)	

One light year = _____ km

If you multiplied correctly, your last number should have a 9 in the place to the left of hundred billions. What is the name of this place?

Problem B

The nearest star visible from earth is more than 4 light years distant. About how many kilometers is this?

12. Computation with Measurement of Time

Objective: **Students will compute measurement in order to solve the problems.**

Materials: Computation of Time Worksheet, Time Computations Worksheet

Benchmark Skills
30) Solve a problem involving time

Vocabulary: A.M., P.M.

Preparation: Background may include a review of time measurement.

Procedure:

1. Present the sample problems, and work through them with the whole group.
2. Have students solve the problems on the worksheet at an individual pace. Ask students to think about the hints presented before solving these problems.
3. Encourage a discussion of the problems and method of solution.

Extension: Ask student to set up a timetable and have a friend write the problems.

COMPUTATION OF TIME WORKSHEET

PROBLEM A

The Lyons family is planning to travel by bus from Central City to Springfield. The 4 buses listed below make this trip daily. Which bus takes the least amount of time?

Bus Numbers	Leaves Central City	Arrives Springfield
427	6:10 A.M.	11:55 A.M.
317	10:20 A.M.	4:25 P.M.
28	3:30 P.M.	9:10 P.M.
50	8:05 P.M.	1:25 A.M.

HINTS: The trip on Bus 427 will take 5 hr and 45 min

To find the time for Bus 317, add the time from 10:20 A.M. to 12:00 Noon (1hr and 40 min) to the time from 12:00 Noon to 4:25 P.M. (4 hr and 25 min).

1. How long will the trip take on Bus 317? Bus 28? Bus 50?

2. Bus ? takes the least amount of time.

PROBLEM B

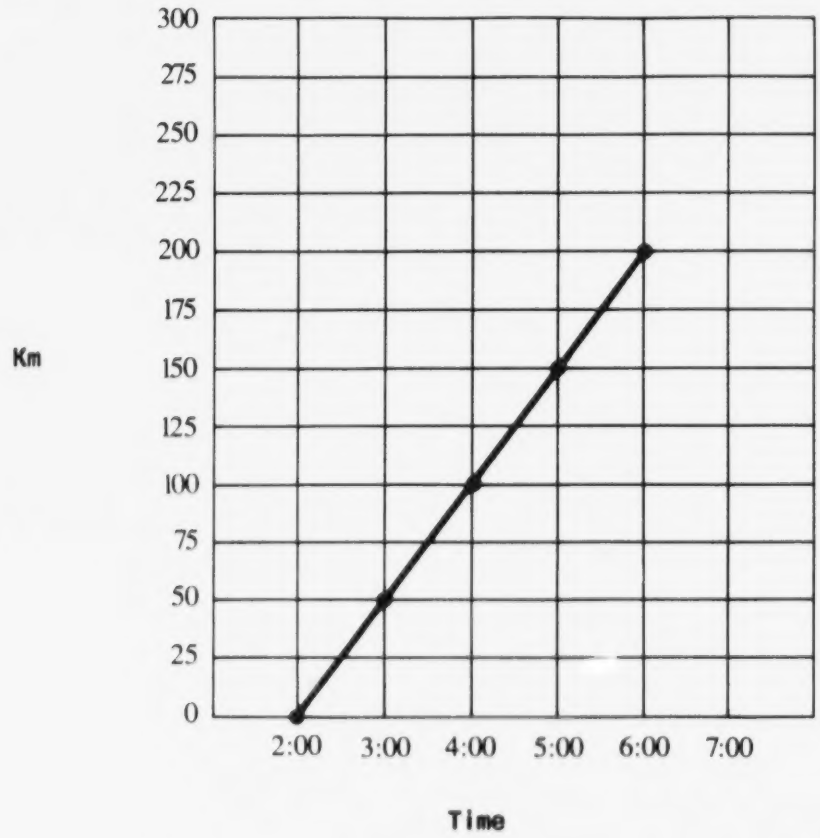
Martina leaves the house at 2:00 driving at 50 km/hr. Her brother, Hector, leaves the house one hour later, heading in the same direction. If he drives at 75 km/hr. and neither driver makes any stops, at what time will Hector pass Martina?

HINTS: A graph will show the number of kilometers each driver has driven by the end of each hour.

At 2:00, Martina has driven 0 km.
By 3:00, she has driven 50 km.
By 4:00, Martina has driven 100 km.

At 3:00, Hector has driven 0 km.
By 4:00, he has driven 75 km.

Copy the graph that follows on graph paper. To complete the graph, place an X to show the distance Hector has driven for each time shown. Draw a line through the X's.



1. How many kilometers has Hector driven by 5:00? by 6:00?

2. At what time does Hector pass Martina?

TIME COMPUTATIONS WORKSHEET

1. At 1:00 P.M. Tom made a phone call to a friend in St. Louis. They talked for 21 min. That night, Tom called his sister in New York. Their conversation lasted for 18 min. To the nearest dollar, about how much will the calls cost Tom?

	8 A.M. - 5 P.M.		5 P.M. - 11 P.M.	
Rates for Calls to:	First Minute	Each Additional Minute	First Minute	Each Additional Minute
St. Louis, Mo.	$.52	$.36	$.33	$.24
New York, N.Y.	$.44	$.30	$.28	$.20

2. Ted wants to barbecue a chicken to serve at 6:30 P.M. The charcoal must burn for 25 minutes before placing the chicken on the grill. If Ted plans to cook the chicken 35 minutes, what time should he start the charcoal?

3. Bruce plans to leave his house at 10:00 A.M. to ride his bike to the beach 20 km away. He rides at a speed of 15 km/hr. If he must be home by 5:00 P.M., how much time will he be able to spend at the beach?

4. Stanley takes two buses from work each day. Each bus ride takes 17 minutes with a nine-minute wait between buses. It takes Stanley another 5 minutes to walk from the bus stop to his home. If Stanley boards the first bus at 5:05 P.M., will he be home by 5:55 P.M. each day?

13. Problem Solving with Temperature

Objective: **Students will calculate and measure temperature changes.**

Benchmark Skills

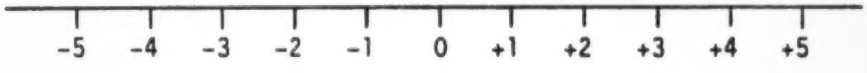
28) Add, subtract, multiply, and divide measures
33) Work with thermometers given a temperature on a Fahrenheit and/or Celsius thermometer

Materials: number lines, thermometers, Temperature Measurement Worksheet, and a large classroom thermometer.

Vocabulary: thermometer, Fahrenheit, Celsius

Preparation: Use a number line to familiarize students with "reading" a thermometer before beginning this activity.

Sample Number Line



Procedure:

1. Explain calculations of integers through the use of the number line and thermometers.
2. Demonstrate with a large thermometer.

Extension: On paper draw a Fahrenheit thermometer. Look in a local newspaper for the daily high and low temperatures for your geographic area. Use a red pencil to mark the high and a blue pencil to mark the low. Write a word problem using these temperatures.

TEMPERATURE MEASUREMENT WORKSHEET

1. The temperature was -3°F at 6 A.M. and +11°F at noon. How many degrees did the temperature rise?

2. The temperature in Presque Isle was -14°F. Freezing is +32°F. How many degrees below freezing was it?

3. The temperature in Bangor was 10 degrees warmer than in Presque Isle. What was the temperature in Bangor?

4. The temperature in Perth Amboy was +54°F. The temperature was 9 degrees lower in Somerville. What was the temperature in Somerville?

5. The temperature was 7°C. By midnight it had dropped 8 degrees. What was the temperature at midnight?

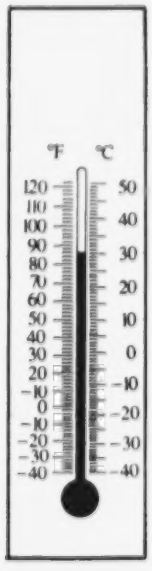
6. The temperature at 8 A.M. was 16°C. By 5 P.M. it had increased 7 degrees. What was the temperature at 5 P.M.?

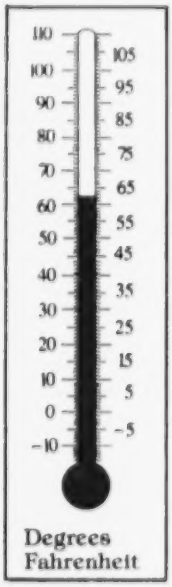
7. If the temperature is 40°F at 8 A.M. and is 60°F at noon, what is the average rise per hour?

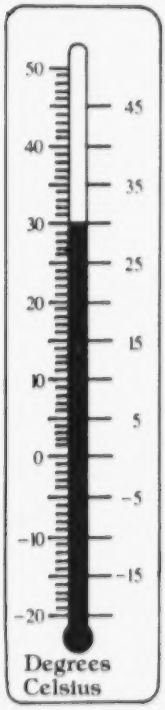
8. The average daily temperature in New Jersey during May is 80°F. The average daily temperature in Fairbanks, Alaska, is one half of that at that same time. What is the average temperature in Fairbanks?

9. The temperature in Richmond, Virginia, is 102°F. On the same day the temperature in Marquette, Michigan, is two thirds of the amount in Richmond. What is the temperature in Marquette?

10. In May the average temperature of the Atlantic Ocean near New Jersey is 55°F. By September that average is 78°F. What is the difference?







14. Identify Figures and Patterns

Objective: **Students will identify and discuss figures and patterns.**

Benchmark Skills
40) Identify geometric figures

Materials: pattern blocks (see Appendix D for templates), pattern blocks for the overhead projector, and an overhead projector.

Vocabulary: Use the terms in step 6 of the procedure on pages 45-46.

Preparation: As background information for this activity, introduce students to the properties of polygons. Students should know the characteristics of: right, obtuse, and acute angles; parallel lines; and closed figures.

Procedure:

1. Display several geometric figures on the overhead projector, placing the figures close together, and ask students to describe what they see.
2. Ask them if they would group any of the figures together because of similar characteristics. Have students verbalize their reasons.
3. Ask if any one figure stands out as "really different" from the others and why.
4. Ask the students to discuss similar figures.
5. Ask the students if any of the figures makes up a fractional part of another figure on display.
6. Continue to question students while changing and mixing figures on the overhead. Use these changes to frame questions on the following:

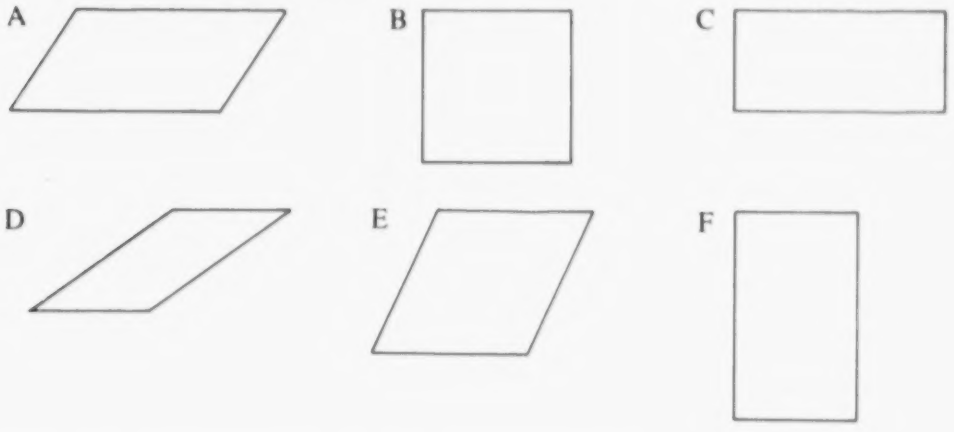
   one-to-one correspondence (lines, angles);
   sorting and matching;
   geometric forms and relationships;
   patterns;

symmetry;
congruence and similarity;
problem solving;
linear and area measurement;
relationships among hexagons, trapezoids, parallelograms and triangles.

7. Divide the class into small groups. Provide each group with some pattern blocks and a list of pre-prepared questions similar to those in steps 1 through 5 of this activity.

8. After allowing sufficient time for small-group discussion and questioning, have each group report significant points to the class.

Enrichment: Use a worksheet with figures from the pattern block box and have students manipulate measurement instruments in order to complete directions.



Draw the two diagonals of each parallelogram.

Use a ruler to find which diagonals have been bisected, or separated into two equal parts.

Which diagonals form right angles? Those that do are perpendicular.

Which diagonals can be called perpendicular bisectors of each other?

15. Types of Angles

Objective: **Students will determine the types of angles.**

Note: Maintaining skills and reviewing concepts is a year-long process. This activity provides a quick review of concepts students should have mastered previously. If the material is new, however, follow each step of the procedure.

Benchmark Skills

35) Understand the concept of a right angle

Materials: Angle Concepts worksheet, teacher-prepared transparencies, and models

Vocabulary: angle, right, acute, obtuse, supplementary, complementary

Procedure:

1. Use pattern blocks to introduce and discuss types of angles.
2. Display large examples of a right angle, an acute angle, and an obtuse angle.
3. Use a protractor, and show the measurement in degrees for each example.
4. Have students practice naming the degrees in the angles and the angle type.
5. Use a protractor on a straight line to show supplementary angles.
6. Vary the size of angles, and have students practice with both supplementary and complementary angles.
7. Use a transparency with various angles, measure the size with a protractor right on the overhead.

ANGLE CONCEPTS

Examples:

A 90° angle
is a **right** angle.

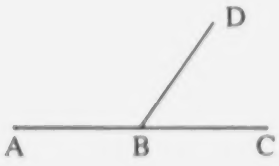
An **acute** angle
is less than 90°.

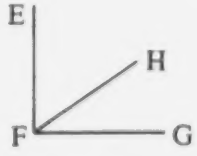
An **obtuse** angle
is greater than 90°.

Two angles whose sum is 180° are **supplementary** angles.

Two angles whose sum is 90° are **complementary** angles.

Practice:





1. ∠ **DBC** is an _____ angle.
2. ∠ **ABD** is an _____ angle.
3. ∠ **DBC** and ∠ **ABD** are _____ angles.
4. ∠ **EFH** is an _____ angle.
5. ∠ **GFH** is an _____ angle.
6. ∠ **EFH** and **LGFH** are _____ angles.
7. ∠ Line **EF** and Line **FG** are _____ angles.
8. ∠ **EFG** is a _____ angle.

16. Circles

Objective: **Students will demonstrate knowledge of the terminology and construction of circles.**

Note: If this material is new to the students, follow each step in the procedure.

Benchmark Skills

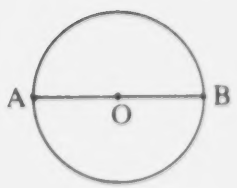
38) Identify the center, radius, and diameter of a circle
39) Understand the relationship between radius and diameter

Materials: compass, rulers, Circle Worksheet, Terms and Definitions Chart, buttons, coins, and worksheets

Vocabulary: circle, diameter, radius (see terms on pages 50-51)

Procedure:

1. Provide students with copies of the Terms and Definitions Chart. Present the terms to be known and the definition of the terms.
2. Draw examples of each term.
3. Encourage students to discuss the terms and the construction of circles.
4. Take a few minutes, and talk the students through drawing circles.



   a. This is a circle.
      Point O is the center of the circle.
      Line segment OA is a radius.
      Line segment AB is a diameter.

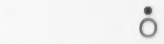
   b. Using a compass: if we hold the point steady and move the pencil all around, we will have a circle.

5. Have students practice drawing circles of several sizes by changing the opening of the compass.
6. Distribute the worksheet, have students complete the work, then discuss the answer.

TERMS AND DEFINITIONS CHART

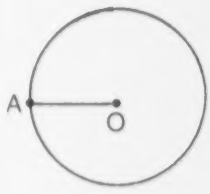
Geometry Geometry is the study of space and shapes in space.

Point A geometric point is considered to be a specific location in geometric space. A point does not have length, width, or depth, but can be pictured by a small dot. We name points with capital letters.

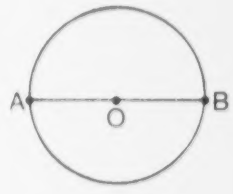


Circle A circle is the set of all points in a plane that are a given (or equal) distance from a given point, called the center.

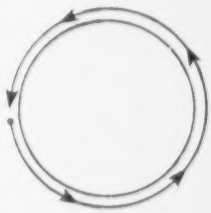
Radius A line segment extending from the center of a circle to any point on the circle itself is called a radius. (Plural: radii)



Diameter A line segment extending from one point on a circle to another point on the circle and passing through the center is called a diameter.

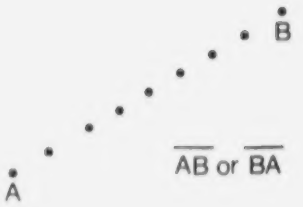


Circumference The distance around a circle is called the circumference.



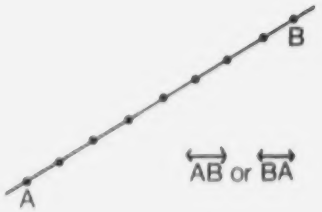
Line segment

A segment can be thought of as a set of points that forms the shortest path between two points. The segment from point A to point B can be denoted by $\overline{AB}$ or $\overline{BA}$. Points A and B are called the end points of the line segment.



Line

A line is the figure one obtains by extending a line segment through each of its end points so that the figure extends endlessly in each of two opposite directions. If A and B are any two different points on a line, the line can be denoted by $\overleftrightarrow{AB}$ or $\overleftrightarrow{BA}$.

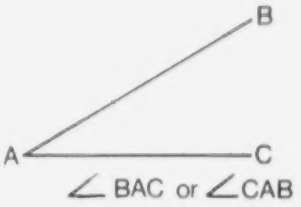


Ray

A ray is formed by a line beginning at a given point and extending in one direction through all points falling along that line. The given point is the end point of the ray. If C is the end point of a ray that passes through a second point D, then the ray can be denoted by $\overrightarrow{CD}$.

Angle

An angle is the union of two rays that have a common end point and do not lie along the same line. If AB and AC are rays that are not on the same line, then their union is an angle, which can be denoted by $\angle BAC$ or $\angle CAB$.



CIRCLE WORKSHEET

1. Draw a circle with a diameter of:

   a. 3 cm b. 2 cm c. 1 cm

2. Draw a circle with a radius of:

   a. 3 cm b. 2 cm c. 1 cm

3. Use this drawing to complete the following statements:

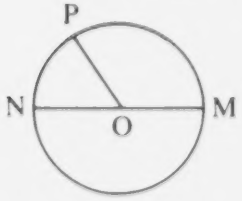
   a. Point O is the _____ of the circle.

   b. Line segment OF is a _____ of the circle.

   c. Line segment RN is a _____ of the circle.

   d. Line segment OR is a _____ of the circle.

4. Use a ruler to finish the drawing. Then complete the following statements:



   a. Radius OP is _____ cm long.

   b. Diameter MN is _____ cm long.

   c. Radius OM is _____ cm long.

EVALUATION

1. Give the names of the line segments for:

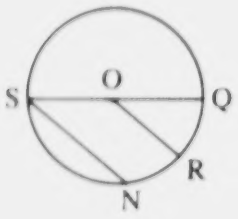
   a diameter _____

   two chords _____

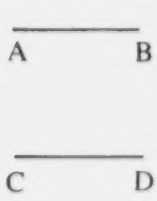
   three radii _____

   _____

   _____



2. Tell the relation of:



3. Express the following in cm: (Use metric length from Appendix)

   42 mm 8 dm 1.4 m

4. What is the radius of a bicycle wheel whose diameter is 26 inches?

5. A rectangle 5 inches wide has an area of 60 square inches. What is its length?

APPENDIX A

A Sample Lesson

INTRODUCTION TO A SAMPLE LESSON

Included on the pages that follow are the procedures in a sample lesson. This is intended to give direction to teachers of grades four, five, or six. The components of this sample lesson should be elements in a daily lesson in the intermediate mathematics classroom.

Sample Lesson

Objective: Students will compute the area of a triangle.

Materials: teacher - prepared example

Vocabulary: triangle, rectangle, right angle, right triangle

Do Now: (Opening Activity) The purpose might be to find the readiness level of students. Involve all students.

SAMPLE DO NOW

Find the Product:

a. .5 x 3 cm x 5 cm =

b. .5 x 6m x 8 m =

Homework: Use an overhead transparency to facilitate **homework correction.**

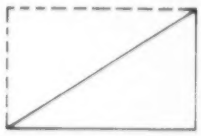
Background: Review the different types of triangles that the students have seen in class and daily life. If necessary, use pattern blocks on the overhead projector to put triangles together in the form of rectangles. Use paper rectangles, and cut them in front of the class to show two triangles. Place the triangles on the overhead, and move them back together to form a rectangle.

Review the formula for finding the area of a rectangle:

$$A = l \times w$$

Procedure:

1. Draw the triangle on the chalkboard in blue or orange.
2. Using a different color, draw in dotted lines to transform the original triangle into a rectangle.



3. Explain to students that the triangle is one half of the rectangle.
4. Help students conclude that the area of a triangle is also one half the area of a rectangle.

   Area of a Rectangle: **A = b x h** or **A = l x w**

5. Give the formula:

   $A = \frac{1}{2}\ a\ b$ or $A = \frac{1}{2}\ b \times h$

   $A = \frac{a\ b}{2}$ or

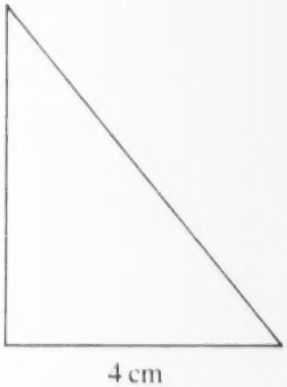
   $A = .5 \times a \times b$ $A = \frac{1}{2}\ l \times w$

6. Model the computation for finding the area of a triangle for the students.
7. Formula: $A = \frac{1}{2}\ a\ b$

   $A = \frac{1}{2} \times 5\text{ cm} \times 4\text{ cm}$

   $A = \frac{1}{2} \times 20\text{ cm}^2$

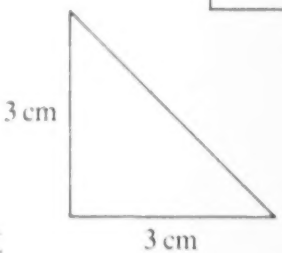
   $A = 10\text{ cm}^2$



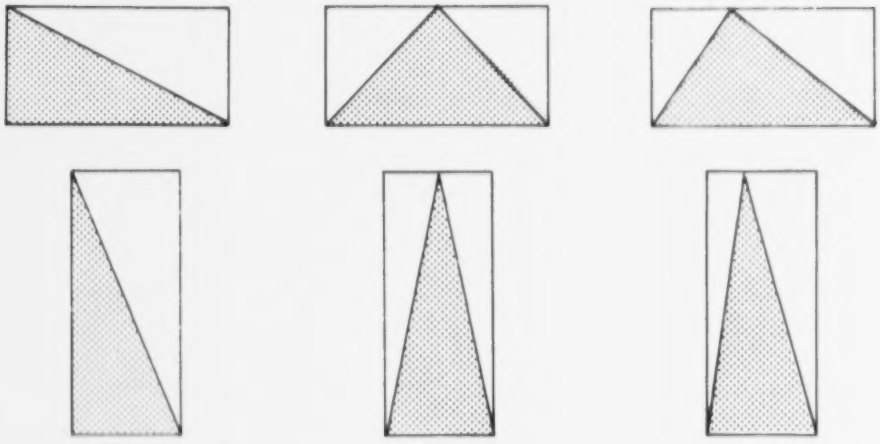
8. Formula: $A = \frac{a\ b}{2}$

   $A = \frac{3\text{ cm} \times 3\text{ cm}}{2}$

   $A = 4.5\text{ cm}^2$



SAMPLE RECTANGLES TO BE CUT INTO TRIANGLES



Practice: An essential component of developmental instruction is **controlled practice**. Ask questions that guide students. Talk through any concerns.

Independent Work: Have students create a few right triangles and compute the area.

Assignment: Keep homework assignments meaningful.

Where possible, assign some research into the topics presented in the activities. Students can report upon these topics in either written or oral format.

APPENDIX B

Review/Evaluation Activities

Around the World Review

Objective: **Knowledge of basic facts, measurement equivalents, and/or geometric shapes.**

Note: Prepare flashcards similar to examples below and use throughout the year to help students maintain basic facts.

Benchmark Skills

36) Identify parallel lines

Materials: Use flashcards similar to the examples that follow.

EXAMPLES

Measurement Equivalents

1 yd = _____ in

2 m = _____ cm

1 gal = _____ qt

3 wk = _____ days

Estimate: Round Decimals to the Nearest Whole Number and Multiply

3.2m x 8m =

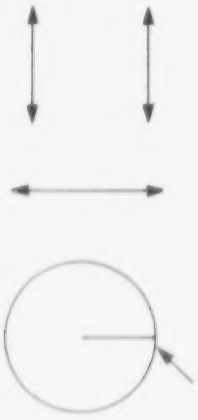
6.9h x 4 =

7.3cm x 5cm =

6.08mm x 7mm =

5.81min x 3.2 =

Identifying Geometric Shapes



Procedure:

1. Tell students that they are going to play "Around the World" with measurement equivalents flashcards.
2. The first student stands beside the second student. The student with the first correct answer to the flashcard question moves on to compete with the next student.
3. If a student should miss the question, he/she sits down, and the student with the correct answer tries to move around the world.
4. Continue until all students have a chance or for a set time limit.

Concentration Review

Objective: **This concentration game can be used to review measurement equivalents or to match geometric shapes to the proper names.**

Note: Have each student prepare a deck of cards similar to examples below. The students can then use the cards throughout the year to review basic facts.

Materials: a deck of cards for each student similar to examples below

SAMPLE EQUIVALENTS

1 mile	•	5280 ft	1 yr	•	12 mo
1 yd	•	36 in	1 yr	•	365 days
1 yd	•	3 ft	1 gal	•	4 qt
1 ft	•	12 in	1 qt	•	2 pt
1 hr	•	60 min	1 lb	•	16 oz
1 day	•	24 hr	1 ton	•	2000 lb

Procedure:

1. Have students make their deck of cards and choose a partner.
2. Shuffle the deck of cards, and place them face down on the desk.
3. Students take turns turning over cards and looking for matches.
4. If a match is found, the student keeps the cards and takes another turn. If the cards do not match, it is the other players' turn.
5. The winner is the student who has the most matches at the end of the game.

APPENDIX C

Measurement Tools

TABLE OF MEASURES

Metric	United States Customary
Length	
1 millimeter (mm) = 0.001 m	1 foot (ft) = 12 inches (in)
1 centimeter (cm) = 0.01 m	3 feet
1 decimeter (dm) = 0.1 m	1 yard (yd) = 36 in
1 meter (m) = 1 m	1,760 yd
1 dekameter (dam) = 10 m	1 mile (mi) = 5,280 ft
1 hectomter (hm) = 100 m	
1 kilometer (km) = 1,000 m	
Area	
1 square centimeter (cm^1) = 100 millimeters (mm^2)	1 square foot (ft^2) = 144 square inches (in^2)
1 square meter (m^2) = 10,000 cm^2	1 square yard (yd^2) = 9 ft^2
Volume	
1 cubic centimeter (cm^3) = 1,000 millimeters (mm^3)	1 cubic foot (ft^3) = 1,728 cubic inches (in^3)
1 cubic meter (m^3) = 1,000,000 cm^3	

Metric	United States Customary

Capacity

Metric	United States Customary
1 milliliter (mL) = 0.001 l	1 fluid ounce (fl oz) = 2 tablespoon (tbsp)
1 centiliter (cL) = 0.01 l	1 cup (c) = 8 fl oz
1 deciliter (dL) = 0.1 l	1 pint (qt) = 2 pt
1 liter (L) = 1 L	1 gallon (gal) = 4 qt
1 dekaliter (daL) = 10 l	
1 hectoliter (hL) = 100 l	
1 kiloliter (kL) = 1,000 l	
1 metric cup (c) = 250 ml	

Mass/Weight

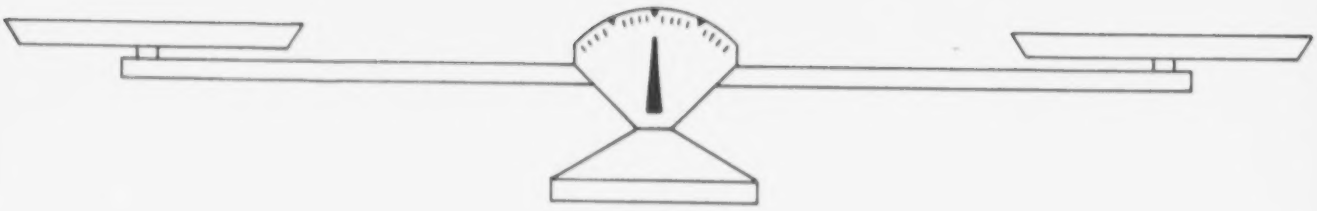
Metric	United States Customary
1 milligram (mg) = 0.001 g	1 pound (lb) = 16 ounces (oz)
1 centigram (cg) = 0.01 g	1 ton (T) = 2,000 lb
1 decigram (dg) = 0.1 g	
1 gram (g) = 1 g	
1 dekagram (dag) = 10 g	
1 hectogram (hg) = 100 g	
1 kilogram (kg) = 1,000 g	
1 metric ton (t) = 1,000 kg	

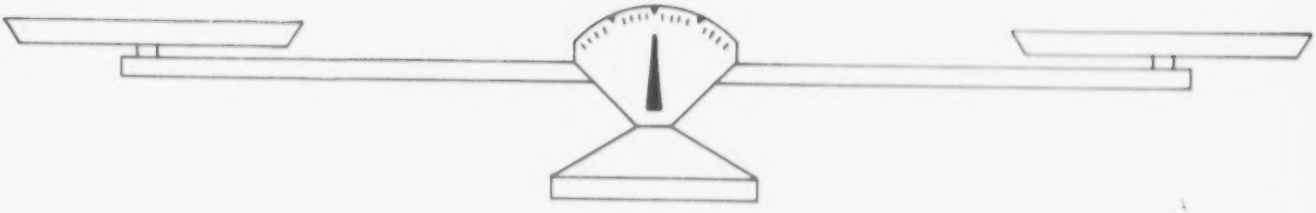
Time

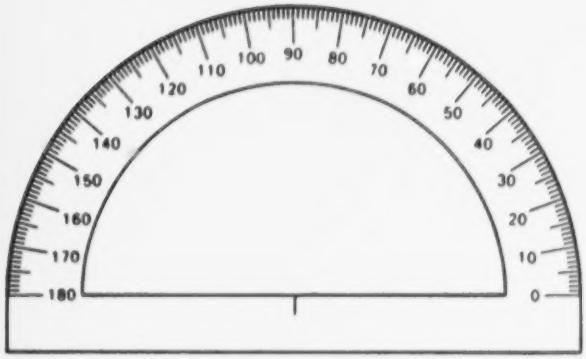
1 minute (min) = 60 seconds (s)
1 hour (h) = 60 min
1 day (d) = 24 h
1 week (wk) = 7 d
1 month (mo) = 28-31 d
1 year (yr) = 12 mo
1 century (cen) = 100 yr

APPENDIX D

Templates



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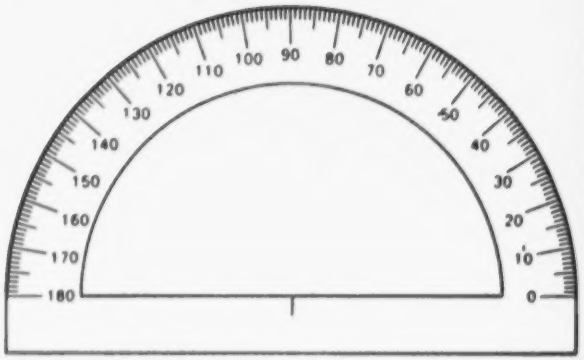
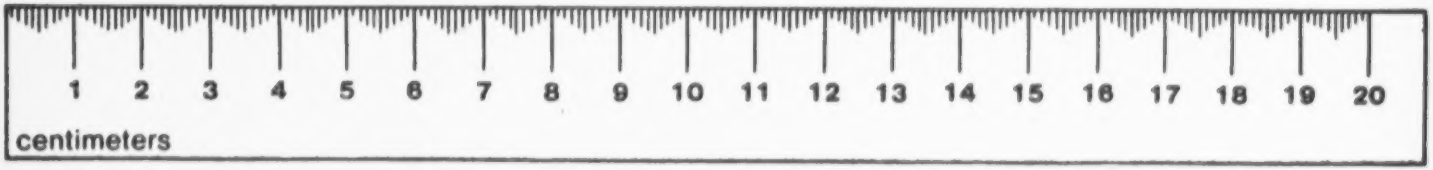
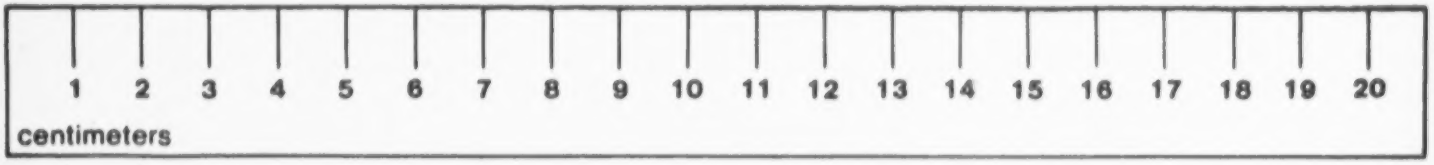
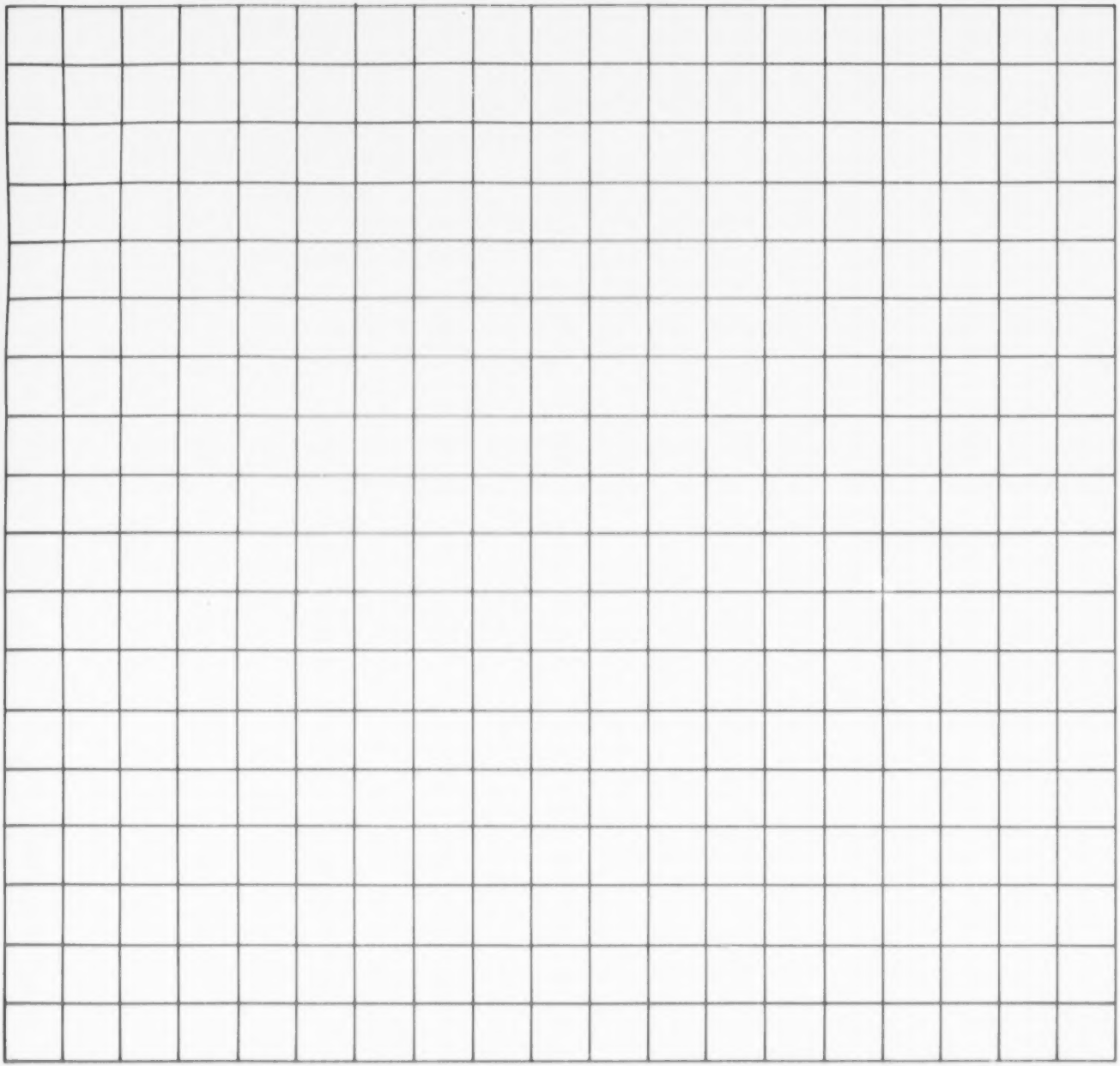

180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

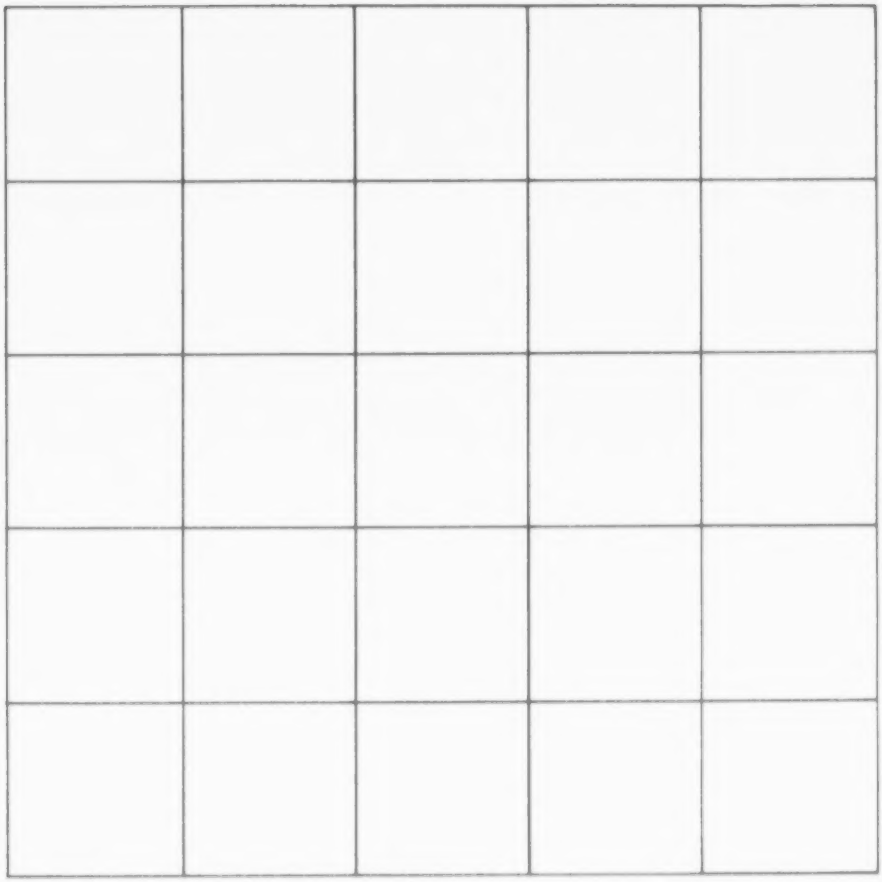
1 2 3 4 5 6 7 8
inches

1 2 3 4 5 6 7 8
inches


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
centimeters


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
centimeters





APPENDIX E

Logo Programming

Sample Logo Program

Objective: **Students will use LOGO.**

Note: The tie-in of LOGO is only recommended. A lesson on the computer should always be well-prepared.

SUMMARY OF SOME COMMANDS

LOGO

Command	Abbreviation
FORWARD	FD
BACK	BK
LEFT	LT
RIGHT	RT
HOME	
PENUP	PU
PENDOWM	PD
PENCOLOR	HT
BACKGROUND	ST
PENERASE	PC
CLEARSCREEN	CS
DRAW	
TO...	
REPEAT	

Materials: Apple Logo, Apple II E/C Computers

Procedure: 1. Have students draw a square.

```
FD  30
RT  90
FD  30
RT  90
FD  30
RT  90
FD  30
RT  90
```

2. Discuss the four angles and how each was constructed.

3. Introduce the definition of a right angle.

4. To develop the definitions for acute and obtuse angles, have students experiment with the turtle, drawing angles greater than and less than 90 degrees.

Acute Angle	Obtuse Angle
RT 90	RT 90
FD 40	FD 40
LT 135	LT 60
FD 40	FD 40

5. Have students draw an equilateral triangle (60° at each angle).

6. Discuss the results. Ask:
   What happens if the turtle turns "right 60"?
   What number must they use to make the turtle point in the opposite direction?

7. Use this discussion to develop the definition of supplementary angles?

SAMPLE GEOMETRIC SHAPES

LOGO PROGRAMS

```
TO TRIANGLE
REPEAT 3 [FD 30 RT 120]
END

TO SQUARE
REPEAT 4 [FD 30 RT 90]
END

TO PENTAGON
REPEAT 5 [FD 30 RT 72]
END

TO HEXAGON
REPEAT 6 [FD 30 RT 60]
END

TO SEPTAGON
REPEAT 7 [FD 30 RT 51]
END

TO OCTAGON
REPEAT 8 [FD 30 RT 45]
END

TO NONAGON
REPEAT 9 [FD 30 RT 40]
END

TO DECAGON
REPEAT 10 [FD 30 RT 36]
END
```

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FEEDBACK FORM

Improving Mathematical Skills Assessed on the High School Proficiency Test

Improving Measurement and Geometry Skills of Students in Grades Four to Six

The Department of Education would appreciate your reaction to this document. Please answer the questions below after you have used this document for more than four weeks. You may photocopy this form for your response.

Teaching Assignment or Title _____

Grade Level ____ Years Teaching ____

Number of Years Teaching Primarily Math _____

Certification(s) _____

A. How did you obtain this resource book?

____ Workshop
____ Central Office
____ Principal
____ Other Teacher
____ Other _____

B. What training (assistance) did you receive in the use of this document? Would you like to have additional training?

C. Please describe any specific changes you have made in teaching percents as a result of using this resource book.

D. What specific changes if any, would you recommend for this resource book? Cite specific activities.

E. With whom have you shared this resource book?

_____ Teacher(s) (specify grade level __)

_____ Principal/supervisor

_____ Department chairperson

Other(s) _____

F. Other observations and remarks:

(Optional)

Name: _____

Address: _____

_____

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NOTES